Hydrogeology of oil and gas deposits of the northern district of West-Siberian artesian basin on the example of the Ugno-Parusovogo field

Daria Budanova
Lomonosov Moscow State University, Moscow, Russia (budanova_daha@mail.ru)

The article considers the conditions of ground water formation in the Yuzhno-Parusovoye oil and gas field, located in the Nadym-Pur-Taz district, YaNAO, Tyumen region. The question of the formation of ground waters of oil and gas complex of the Yuzhno-Parusovoye fields is of fundamental importance for the study of hydrogeological conditions of oil fields in the northern areas of the W-Siberian Megabasin. Yuzhno-Parusovii license area is located above the Arctic Circle in the NW-Tazovsky Peninsula. The area is composed of rocks of the Paleozoic folded basement and terrigenous Mesozoic-Cenozoic sedimentary cover (sand and clay). On the territory of the Tazovsky Peninsula, Paleozoic education wells were opened. According to seismic materials, the depth of their roof varies from 6.3 up to 10.0 km. The total thickness of the Paleozoic cover in the area is 1-3 km. The tectonic structure of the Yuzhno-Parusovoye Deposit comprises three structural-tectonic floors: the lower-Paleozoic Foundation, middle-Paleozoic-Triassic riftogenic volcanogenic-sedimentary complex and upper Mesozoic-Cenozoic platform sedimentary cover. Concerning hydrogeology, the Yuzhno-Parusovii license area consists of two water systems, superimposed on each other: the Mesozoic-Cenozoic and the Riphean-Paleozoic. Thus only the upper part of the Mesozoic-Cenozoic water system is studied, which will coincide with the sedimentary cover and consists of two hydrogeological levels.

Data on the hydrodynamic characteristics of the field are difficult to interpret; therefore a special attention is paid to the aquifers of the Yuzhno-Parusovoye field. On this territory, there are pre-requisites for the formation of the inverse hydrochemical zonality.

Normal vertical hydrochemical zoning of groundwater is manifested through a cross section of the earth's crust and is expressed in a regular change of hydrodynamic and hydrochemical parameters. It is an obvious change of genetic types of water of HCO_3-Ca-SO_4-Na through the Cl-Mg, Cl-Ca from areas of the external power supply to the Central most omitted parts of the basin. Along with the normal, in many artesian basins, especially in the oil and gas bearing structures, the presence of the hydrochemical inversion is noted. Inversion of vertical hydrochemical zonality, which are characterized by well marked reduction of mineralization of groundwatert the depth of the aquifer and corresponding changes in their chemical composition, are currently for hydrogeological areas of different types.

Types of inversion cuts original unit in three groups. Group with a local increase in the salinity in the upper parts of the section, preserving ancient infiltration water and education «revived» fresh waters of the recrystallization clays, introduction of deep fresh water from the more high temperature zones of the sedimentary cover or from the basement. Special attention will be paid to the last two types of inversions. Proceeding from the aims of the work, the lower hydrogeological level, which is associated with the major hydrocarbon fields is discussed.

Test results show salinity decrease from 18 g/l up to 6 g/l on average in the upper Cretaceous during the transition to lower Cretaceous. In addition, there is a change of water type from Cl-Ca to HCO_3-Na. It should also be noted that the absolute and relative content of HCO_3 ions in the waters increased from 4.3 to 23.7 variance%. Simultaneously with the increased content of HCO_3 ions micro component composition is changed, which manifests itself in increasing B/Br ratio with depth. To determine the Genesis of the deep waters of Yuzhno-Parusovoye fields B/Br ratio was used. Increase of B/Br ratio points to the inflow of high-temperature water into the reservoir. Both of these elements are present in oceanic waters, in fairly constant amounts average content of Br is about 65 mg/l, the average content of B varies in the range of 5 to 12 mg/l. However, the conditions of accumulation of these elements in the ground waters differ significantly.

Thus, if we take the average value of the B/Br ratio for oceanic water (0.08-0.18) the sharp increase will testify the receipt of B with high-temperature deep fluids. B/Br ratio varies from 0.95 to 3.9. With depth an increase is observed in the B/Br ratio. Increase of B/Br ratio can be connected to two reasons: 1) removal of argillaceous rocks high temperature water (T>100); 2) the process of evaporation-condensation. To confirm this hypothesis calculations by Bychkov and Kireeva, which was thermodynamic modelling, has resulted in a graph, which is easy to diagnose the presence of condensation water, both anthropogenic and natural origin.

Based on the data of chemical analyses from the Yuzhno-Parusovaya square a graph was constructed to illustrate the dependence of B/Br coefficient on water mineralization. The similarity of the graphs obtained by simulation and by results of chemical analyses, gives us the right to assume the same mechanism of formation of technogenic condensate waters and stratal waters Yuzhno-Parusovoye oil field. In both cases, the chemical composition of water formed as a result of mixing of deep condensate connate waters. The graph shows significant increase in B/Br ratio with decreasing water mineralization.

B/Br relationship gives us the right to say about the transfer of boron with low mineralized waters. This low mineralized water must be very high temperature, because with a temperature increase is associated sharp increase in the relative content of B in water. If reduction of mineralization of the studied water was associated with dilution by infiltration waters, B/Br ratio remained constant, as in seepage waters B and Br present in trace quantities. Thus dramatically increasing in this case B/Br attitude apparently reflects the inflow into the reservoir connate water endogenous deep waters. Increase of B/Br ratio indicates the removal of argillaceous rocks in the high temperature waters and the process of evaporation-condensation. Education fresh formation water is HCO_3-Na Yuzhno-Parusovoye fields (inversion) occurred with the introduction of connate water reservoir of high-temperature gas-steam deep fluids. This is proved by the sharp rise In/VG relations than the values for sea water and sedimentation brines. This increase is due to: 1) condensing vapour and condensate enriched B, compared with the initial solution; 2) B removal of argillaceous rocks of high-temperature waters.